Characterization, pressure, and temperature influence on the compressional and shear wave velocity in carbonate rock

Abstract

Rock characterization and acoustic wave velocity analysis are very important stage in the petroleum reservoir characterization and seismic exploration. Meanwhile carbonate rocks are worthy of attention since they contain at least 40% of the world's known hydrocarbon reserve and have some complexity in porosity, lithology facies and acoustic wave behavior. This paper present detail relationship between porosity and permeability, effect of pressure and temperature to the acoustic wave parameters such as compressional and shear wave velocities. Data collected includes petrography analysis, SEM image, detail core description, and laboratory experimental of acoustic wave velocities measurements in variation of overburden pressure and temperature. Some acoustic wave parameters were simulated as close as possible to the reservoir conditions. Based on the petrophysical data and acoustic wave measurement, the porosity is the main controlling factor of acoustic wave parameter. A plot of porosity versus velocity displays a clear inverse trend to porosity which an increasing of porosity resulting in decreasing of velocity. In addition, increasing of permeability will results in decreasing velocity value. The overburden pressure causes compaction, porosity reduction and increasing in velocity. This performance is slightly changed when temperature increase from 28.73 oC to 62.07 oC, generally both Vp and Vs value become lower. The results can be used for better seismic analysis performance, correspond to increase hydrocarbon discovery from the carbonate rock in the future.